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1879.

THE year 1879 has been, in many respects, a noticeable one, though new discoveries or inventions in the electrical and telegraphic world have not been abundant; but, at the same time, much quiet progress has been made in perfecting and extending the work done in previous years. The meeting of the Telegraphic Congress in London has, undoubtedly, been the event of the year, and for this reason alone 1879 will be marked out in the annals of telegraphy as being eventful, although, of course, the progress of invention and discovery is in no way affected by the fact of this gathering having taken place.

The results of the Congress have yet to be seen, and the resolutions arrived at have yet to take effect; but there can be no doubt but that much good will have been done, and, apart from the mere commercial questions involved, the gathering of so many representatives from every quarter of the globe, and the exchange of ideas and social courtesies amongst so many eminent men, will have been highly beneficial. In his inaugural address before the Society of Telegraph Engineers, Lieutenant-Colonel (then Major) Bateman-Champain pointed out the results that had arisen from the previous Congresses. The Society had the honour of entertaining the members of the Congress, and by this act of courtesy showed its desire to be considered, as much as possible, an International institution.

As the report of the secretary stated, the Society of Telegraph Engineers is in a very flourishing condition, its members numbering over 1,000 strong, whilst it possesses an electrical and telegraphic library unequalled in the world. The papers read and discussed by the Society have been of great interest, and mostly of a very practical nature; this alone indicates the progress which telegraphy and electricity continue to make.

Of all the inventions which have been brought forward during the past year, perhaps the Writing Telegraph, of Mr. Cowper, and the Induction Balance, of Professor Hughes, are deserving of the most notice. Both inventions, when more perfectly developed, are likely to prove of great value. The former was brought before the Society of Telegraph Engineers and excited great interest. The invention of Professor Hughes was described in a paper read before the Royal Society. By its means it was found possible to detect very minute traces of impurities in various metals; the instrument also seems likely to be of great value in determining the state of the auditory nerves of persons in good or bad health.

The progress of the electric light during the year, though considerable, can hardly be considered to have been rapid. Certainly the progress and the results predicted have by no means been realised. Gas has not been, and is not likely to be, superseded as a whole by the electric light. The outside public, whose scientific knowledge is at the best but very limited, take fright very easily, and every new invention or display in electric lighting is regarded by them as another nail in the coffin of the gas companies; the latter are, however, a very long way off from being extinct, though there is undoubtedly great room for improvement in the quality of the article they supply.

The inventions, and patents taken out to secure the same, in connection with the electric light are very numerous. Between July, 1878, and July, 1879, about 80 patents have been taken out which deal directly with the question of electric lighting, and almost every bi-weekly list of published patent specifications finds a further number added. The Patent Office and patent agents are certainly doing a flourishing business in this direction.

The exhibition of electric lighting apparatus held at the Albert Hall at the beginning of May, and which was heralded by a short inaugural address delivered by Mr. W. H. Preece, before H.R.H. the Prince of Wales, brought together a most interesting collection of inventions related to the subject.

The Parliamentary Select Committee, under the presidency of Sir Lyon Playfair, appointed to consider whether "it is desirable to authorise municipal corporations or other local authorities to adopt any scheme for lighting by electricity," gathered information on the subject of electric lighting from every available source, and the evidence of the most eminent experts was obtained; but the committee did not consider that the progress made by the electric light was sufficient for any definite steps being taken in the matter at present; since that time up to the expiry of the last year, although progress has been made, it has not been sufficient to justify the question of practicability being considered as definitely settled.

Very great differences of opinion continue to exist as to the relative cost of electricity *versus* gas, and this question has by no means been satis-

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factorily answered as yet if everything be taken into consideration.

During the year several improved dynamo-machines and lamps have been brought prominently before the notice of the public; amongst the former we may mention the Brush, the Siemens-Alteneck, the Schuckert, and the Elphinstone and Vincent. Mr. Edison has also devised a dynamo-machine which is said to be of remarkable efficiency. On this subject a lively discussion has been carried on for some time, notably on the other side of the Atlantic, but no definite conclusion on the point as yet has been arrived at.

A large crop of electric lamps has sprung into existence, amongst which may be mentioned those of Messrs. André, Edison, Fuller, Heinrichs, Hickley, Higgins, Jamin, Krupp, Lontin, Mori-Griffin, Orme, Rapieff, Reynier, Sawyer-Man, Siemens, Wilde, &c. The candles of M. Jablochkoff and the lamps of other well-known makers have undergone considerable improvements, resulting in added efficiency.

The electric light has been applied to several large buildings, notably to the reading-room of the British Museum. The lighting of the Thames Embankment has also been considerably extended, and the circuits in connection with the same carried to the Victoria Station of the Metropolitan Railway. In several provincial towns the electric light has been applied for lighting factories, &c. Recently another sensational telegram has been received from America announcing the discovery by Mr. Edison, "quite by accident," of a new electric lamp, which is to do wonders.

The use of the telephone is quickly spreading, and already the principal English towns have "telephone exchanges" in full working order, and the movement is likely to extend rapidly.

The telephonic inventions and patents, like the electric lighting patents, are very numerous, and must have added considerably to the receipts of the Patent Office and patent agents, and we hope also to the pockets of the inventors.

The chemical telephone of Mr. Edison is undoubtedly one of the most remarkable inventions of the American genius, and promises great things. The Blake transmitter has also been found very efficient; whilst an invention of our own country, the microphonic transmitter of Mr. Crossley, is remarkable for its extreme simplicity and small liability to get out of order; it has been used with great success. Of the Gower telephone, which seemed one of the most promising forms yet invented, but little has been heard of late, although it was prominently brought before the Society of Telegraph Engineers in the course of the year. The Ader telephone is a foreign invention which has furnished some good results.

In general telegraphy, fair progress has been made. Though no remarkable inventions have been brought forward, the new duplex of Messrs. Theiler is, however, worthy of notice. The improved battery of Howell also seems likely to be of considerable value.

The military disasters at the Cape Colony have resulted in the establishment of telegraphic communication between that place and the rest of the civilised world, thus completing about the last important link of the vast network of cables now laid all over the globe. The laying of another Atlantic cable has rendered telegraph communication between the Old World and the New still more secure.

The problem of the transmission of power to a distance has received a considerable impulse during the year, but at present the subject is quite in its infancy, and the actual progress made has been but small. The experiments of M. Menier, however, in ploughing by electric power through the agency of a Gramme motor, have excited considerable interest.

Death has been active during the year, and we have to regret the loss of several most eminent electricians and scientific men. Amongst these we may mention Professor Clerk-Maxwell, Sir William Fothergill-Cooke, Mr. R. S. Brough, in our own country, and Professor Volpicelli abroad.

TELEPHONE EXCHANGES AND THE POSTAL TELEGRAPHS.

THE now rapid progress in England of the system of telephonic exchanges is bringing into notice the peculiar position in which the postal authorities are placed by the use of that beautiful electrical instrument, the speaking telephone. At the time most of the Telegraph Acts were framed there was no anticipation of the transmission of articulate sounds along a telegraph wire, and it becomes at the present time a nice question as to how far the Telegraph Acts can be applied to protect the Government monopoly from what it is thought, rightly or wrongly, might become, so far as the aforesaid monopoly is concerned, a serious interloper. It may be of interest to many of our readers if we recite a few of the passages in the Acts before mentioned which seem most nearly to touch on the subject. In 1869 was passed an "Act to alter and amend the Telegraph Act, 1868." The preamble contains the following:—

And whereas, in order to protect the public revenue, it is expedient that similar powers to those conferred upon the Postmaster General with respect to the exclusive privilege of conveying letters should be enacted with reference to the transmission of public telegraphic messages within the United Kingdom of Great Britain

and Ireland; and that the said Act should be amended in other respects.

This clearly makes it the duty of those in authority in the Telegraph Department to enforce the Act where necessary, for the protection of the revenue. In paragraph 3 it is stated :—

The term "telegraph" shall, in addition to the meaning assigned to it in "The Telegraph Act, 1863," mean and include any apparatus for transmitting messages or other communications by means of electric signals :

The term "telegram" shall mean any message or other communication transmitted or intended for transmission by a telegraph.

Here it will be perceived is mentioned the word "signals," and it is probable a contention will arise as to the meaning of the word. Is an articulate sound a signal? The passage as to the word "telegram" depends on the particular interpretation observed in the preceding paragraph.

By reading paragraphs 4 and 5 :—

4. *The Postmaster General, by himself or by his deputies, and his and their respective servants and agents, shall, from and after the passing of this Act, have the exclusive privilege of transmitting telegrams within the United Kingdom of Great Britain and Ireland, except as hereinafter provided; and shall also within that kingdom have the exclusive privilege of performing all the incidental services of receiving, collecting, or delivering telegrams, except as hereinafter provided.*

5. *There shall be excepted from the said exclusive privileges of the Postmaster General all telegrams of the following descriptions: (that is to say),*

Telegrams in respect of the transmission of which no charge is made, transmitted by a telegraph maintained or used solely for private use, and relating to the business or private affairs of the owner thereof:

Telegrams transmitted by a telegraph maintained for the private use of a corporation, company, or person, and in respect of which, or of the collection, receipt, and transmission or delivery of which no money or valuable consideration shall be or promised to be made or given :

Telegrams transmitted, with the written licence or consent, either special or general, of the Postmaster General, under the hand of any officer of the Post Office, authorised for that purpose by the Postmaster General.

It will be noticed that over telephones for use by private firms, or a corporation or company, the Postmaster General has no authority whatever; here a question is, however, likely to arise. Is intercommunication by means of a telephone exchange an infringement of this law? Is an exchange a company? We have our own opinions on these points, but as they will probably ere long be placed for settlement before the Law Courts we refrain from expressing them at this juncture. It is, nevertheless, certain that telephonic means of communication is now fairly established, and must become in the near future an absolute necessity, and therefore the less interference the Postmaster may find necessary the better. The exchanges are for the convenience of the public, and even supposing the law should be found against them, still it seems to us the case could well be met by the Post Office licensing them by their paying a merely nominal amount. The principal use of the telephone should be over short distances, say a mile or a mile and a half, and over these distances few would telegraph by postal wires, therefore far from being an interloper, it should be considered but as an extension or ramification of the departmental main arteries. It is possible that the authorities at the General Post Office may in duty test the matter, whether they wish it or not, but apart from the expense and obstruction to business which the testing of such well balanced questions involve, the telephone companies have much to gain if they win, and we fancy little to dread if they lose.

ON A NEW FORM OF RESISTANCE BALANCE ADAPTED FOR COMPARING STANDARD COILS.*

By J. A. FLEMING, D. Sc. (University of London), Scholar of St. John's College, Cambridge.

1. The British Association Committee on Electrical Standards concluded their valuable labours on the Unit of Resistance by constructing copies of the selected standard. Certain of these coils, some fourteen in number, are at present preserved in the Cavendish Laboratory at Cambridge. It is important that these coils, which consist of wires of various alloys, should be from time to time carefully compared together in order to determine whether the ratio of their resistances at definite temperatures remains the same.†

Observations ought also at the same time to be made of the temperatures at which they agree, and also of their co-efficients of variations of resistance with the temperature. In using for the purpose the ordinary form of divided-metre bridge, several objections present themselves which render it a tedious process to determine accurately the difference in the resistance of two coils at different temperatures, and hence to deduce their variation co-efficients. It seemed on consideration that a modification of the usual form of Wheatstone's Bridge would render these processes more expeditious and at the same time more accurate. It is the object of the present paper to describe a form of Resistance Balance which has been recently constructed for the Cavendish Laboratory, and which experience shows to have several decided advantages over the old form.

2. *Description of the Resistance Balance.*—A circular disc of mahogany 18 inches in diameter and about 1 inch thick, *f* (see fig. 1), stands upon three short feet, L. Upon this and concentric with it is screwed down a disc of ebonite 14 inches in diameter and $\frac{3}{4}$ of an inch thick, *e*. The ebonite disc has a semicircular groove turned in its circumference. The circular wooden base extends on one side into a narrow rectangle, *j*, 4 inches wide, and of the same thickness as the disc. To this is connected two other rectangular pieces, *h i*, which are joined together by slotted brass bars, *y*, *y'* (see fig. 2), underneath, in such a manner as to permit the two intervals to be made wider or narrower at pleasure. This promontory is of wood of the same material

* Read before the Physical Society, December 13th, 1879.

† A detailed and most careful comparison of these coils was made by Professor G. Chrystal and Mr. S. A. Saunder in 1875, and their report is printed *in extenso* in the Report of the British Association at Glasgow in 1876. This is the most recent occasion on which the coils have been examined.

and thickness as the disc *f*, and is supported and levelled by three levelling screws, *n*, *n'*, *n''*. Through the centre of the ebonite disc passes a brass centre pin, D D' (fig. 2), on which is centred a brass arm, H H', capable of revolving round just free of the disc. Beneath the arm and soldered to it is a short brass spring, *x*, which depends vertically downwards. This spring carries at its extremity a small prism of platinum-iridium, with one edge vertical and turned inwards.

In the groove turned in the disc *e* is stretched a platinum-iridium wire about $\frac{5}{16}$ of an inch in diameter. The wire extends round about $\frac{3}{4}\frac{5}{7}$ of the circumference, and is about 39 inches long, and the groove is of such a size that the wire lies with exactly half its thickness embedded in it. The ends of this wire are soldered to copper strips, *k k*. This wire is represented by the thick black line, A, C, A', in figures 1 and 2. On the wood rectangles, *j*, *h*, *i*, is fastened an arrangement of longitudinal copper strips, *k k*, which connect together eight transverse square copper bars in the manner shown in fig. 1. On the ends of these transverse bars are fixed vertical copper pins $\frac{1}{16}$ of an inch in diameter and $\frac{3}{4}$ of an inch high. On these pins are slipped short lengths of india-rubber tube, which extend beyond the pins, so that they form small cups about 1 inch deep, *s* (see fig. 2). The top of the copper pin is well amalgamated with mercury, and forms the bottom of the cup. These cups are filled about a quarter full of mercury. On the longitudinal strips of copper are fixed three binding screws, B, B', G, and a fourth, G', simply goes through the wood, and is connected by a wire underneath the base board with the centre pin D, and is therefore in metallic connection with the spring *x*. The battery is connected with the terminals B B', and the galvanometer with the terminals G G'. To the arm, H H', is adapted a trigger, T, of such shape that when the button *w*, which is of ebonite, is pressed down the spring *x* carrying the platinum-iridium knife edge is bent inwards until it touches the wire strained round the circumference of *e*.

The arm carries a vernier, *z*, which travels round, sunk in a shallow groove in the face of the ebonite disc, and the ebonite is graduated on the face on the margin of the groove. The graduations are cut into the ebonite and then rubbed over with powdered chalk mixed with gum and water. This gives a graduation very legible and pleasant to look at.

The length of the wire is just 1,000 divisions, and the vernier enables these to be divided into tenths. The zero of graduation is so placed that when the pointer of the vernier reads zero, the knife edge on the spring *x* is exactly opposite the extremity of the platinum-iridium wire.

It is thus clear that the revolving arm carrying its knife edge can be moved round so that on pressing the trigger button *w*, the knife edge makes contact at any point of this wire, and thus connects this point with the terminal G'.

This part of the arrangement answers to the sliding block and piston contact-piece of the ordinary divided-metre bridge.

3. *Method of using the Balance.*—Let now two resistance coils of about equal resistance be provided, and let the coil terminals of one coil be placed in the mercury cups *p* and *r*, and those of the other be placed in *q'* and *s'*. And let two more coils be taken of not very unequal resistance which it is desired to compare with each other; let the terminals of one be placed in the mercury cups *a* and *c*, and those of the other in *b'* and *d'*. It will then be seen that if a battery be connected with B B', and a galvanometer with G G', that we have the usual Wheatstone's Bridge arrangement (see fig. 4, which gives a diagram of the connections).

Two quart Leclanché cells are best suited for ordinary use. If a more powerful battery is used there is danger of heating the platinum-iridium wire, and so expanding it that it may slip down out of its groove.

The coils in the intervals between the cups *p* and *r* and *q'* and *s'* form two branches, and the coil in the interval between *a* and *c*, together with the resistance of the platinum-iridium wire round to the place where the spring *x* touches it, forms the third branch, whilst the coil in the interval *b' d'*, together with the remainder of the wire, forms the fourth. The "Bridge" wire consists of the arm H H' and the wire under the base board together with the galvanometer inserted between G and G'. By moving round the arm H H', and pressing the button *w*, we can find a position where there is no current through the galvanometer. The copper strips, *k k*, are made of copper so thick that their resistance is practically nothing. Having established a balance between the conductors and read the vernier, the next operation is to lift up the legs of the coil which were inserted in the cups *a* and *c* and drop them into the cups *b* and *d*. Likewise a similar change is effected on the other side, the terminals of the coil inserted in *b'* and *d'* are changed to *a'* and *c'*.

An examination of the connections as shown in fig. 1 will show that the result of this operation is as if the coils had *changed places*, whilst preserving their former connection. Now let the arm be moved round and a fresh position of equilibrium found by pressing the trigger and reading the vernier. A little consideration will show that the difference of these readings gives the differences between the resistances of the coils in terms of a length of the bridge wire. For the amount by which one coil exceeds the other in resistance, is equal to the resistance of that part of the bridge wire included between the two readings.*

In order to render this method of determining the difference of two coils practicable, the platinum-iridium wire must be exceedingly uniform in resistance, or else a table of calibration will have to be made. Great pains was taken to procure a length of wire as uniform in size and resistance as possible, and considerable care was taken in laying the wire in its groove not to strain it in any way. It lies evenly in its groove, just sufficient tension being put upon it to keep it in its place. The whole resistance of the wire from end to end is not far from $\frac{1}{10}$ of an ohm at about 15° C.

* This method of obtaining the difference of two resistances in terms of a length of the calibrated bridge wire, was suggested by Prof. G. C. Foster, F.R.S., in a paper read before the Society of Telegraph Engineers, May 8th, 1872. In this paper is given an account of the method of calibrating a wire. It is obvious, without any further proof, that if the coil placed in *a* and *c* exceeds in resistance that placed in *b* and *d*, then on exchanging them, since the united resistance of coil and bridge wire remains the same, that the contact-knife edge must be moved back along the bridge wire by a length exactly equal in resistance to the excess of one coil over the other.

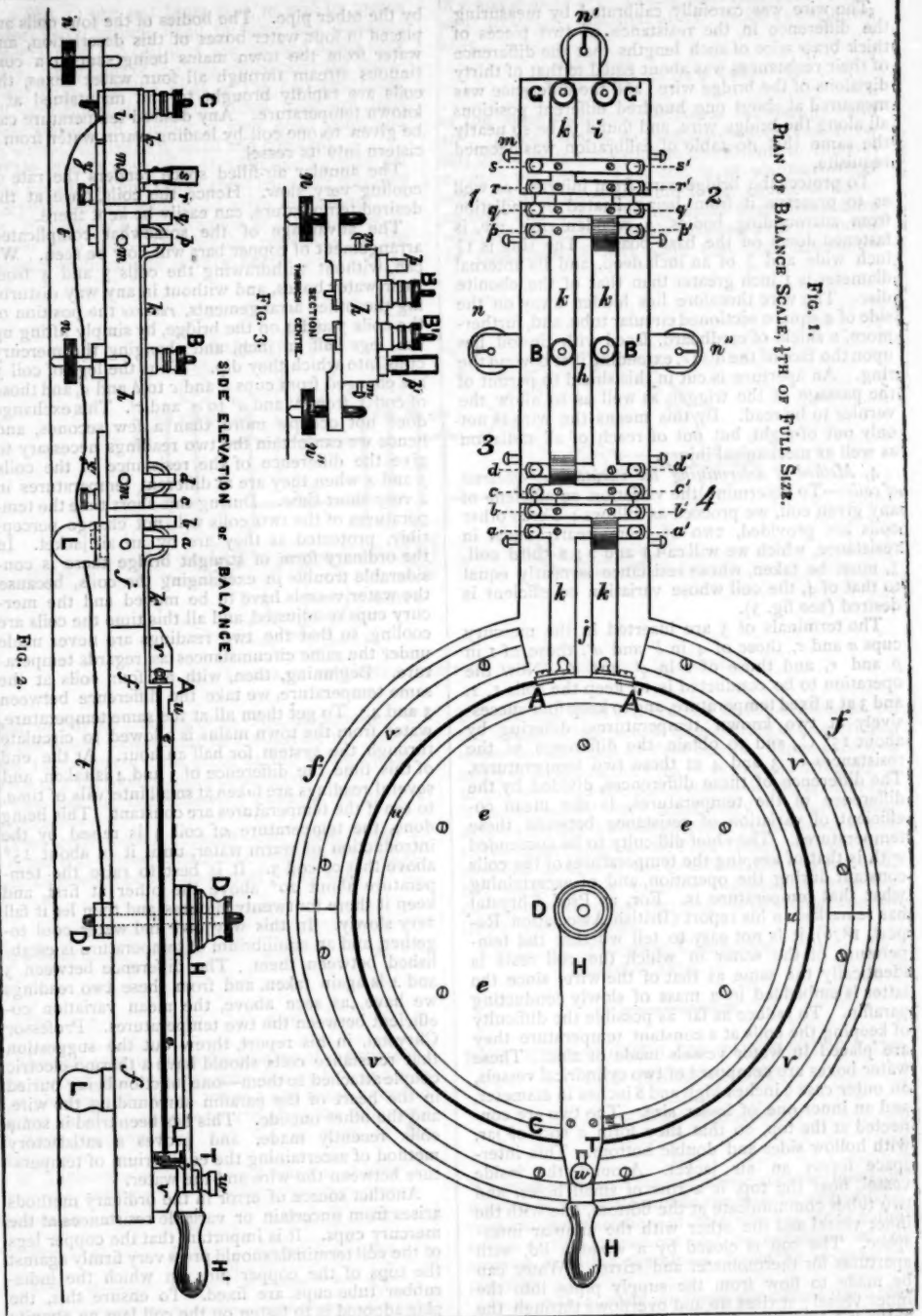


FIG. 2.

FIG. 3.

PLAN OF BALANCE SCALE, 1/4TH OF FULL SIZE.

FIG. 1.

The wire was carefully calibrated by measuring the difference in the resistance of two pieces of thick brass wire of such lengths that the difference of their resistances was about equal to that of thirty divisions of the bridge wire; and the difference was measured at about one hundred different positions all along the bridge wire, and found to be so nearly the same that no table of calibration was deemed requisite.

To protect the bridge wire from injuries, as well as to preserve it from being heated by radiation from surrounding bodies, a wooden ring, *v v*, is fastened down on the base board. The ring is $1\frac{1}{4}$ inch wide and $\frac{3}{4}$ of an inch deep, and its internal diameter is 1 inch greater than that of the ebonite disc. The wire therefore lies hidden away on the side of a square sectioned circular tube, and, furthermore, a shield of cardboard, faced with tin-foil, lies upon the face of the disc *e*, extending just beyond the ring. An aperture is cut in this shield to permit of the passage of the trigger, as well as to allow the vernier to be read. By this means the wire is not only out of sight, but out of reach of all radiation as well as mechanical injury.

4. *Method of determining the variation co-efficients of coils.*—To determine the variation co-efficient of any given coil, we proceed as follows: Three other coils are provided, two of them nearly equal in resistance, which we will call 1 and 2; a third coil, 3, must be taken, whose resistance is nearly equal to that of 4, the coil whose variation co-efficient is desired (see fig. 3).

The terminals of 3 are inserted in the mercury cups *a* and *c*, those of 4 in b' and d', those of 1 in *p* and *r*, and those of 2 in q' and s'. Now the operation to be conducted is to keep the coils 1, 2, and 3 at a fixed temperature, and to keep four successively at two known temperatures, differing by about 15° C., and to obtain the difference of the resistances of 3 and 4 at these two temperatures. The difference of these differences, divided by the difference of the temperatures, is the mean co-efficient of variation of resistance between these temperatures. The chief difficulty to be contended with is that of keeping the temperatures of the coils constant during the operation, and of ascertaining what that temperature is. For, as Prof. Chrystal has remarked in his report (British Association Report, 1876), it is not easy to tell whether the temperature of the water in which the coil rests is identically the same as that of the wire, since the latter is embedded in a mass of slowly conducting paraffin. To reduce as far as possible the difficulty of keeping the coils at a constant temperature they are placed in water vessels made of zinc. These water boxes are composed of two cylindrical vessels, an outer case 9 inches high and 8 inches in diameter, and an inner one of lesser size. The two are connected at the top, so that they form a sort of jar, with hollow sides and double bottom. This interspace forms an air jacket. Around the inside vessel, near the top, is a row of small holes, and two tubes communicate at the bottom, one with the inner vessel and the other with the annular interspace. The top is closed by a wooden lid, with apertures for thermometer and stirrer. Water can be made to flow from the supply pipes into the inner vessel; it rises up and overflows through the holes and drains away down the interspace and out by the other pipe. The bodies of the four coils are placed in four water boxes of this description, and water from the town mains being sent in a continuous stream through all four water boxes, the coils are rapidly brought to and maintained at a known temperature. Any desired temperature can be given to one coil by leading warm water from a cistern into its vessel.

The annular air-filled space renders the rate of cooling very slow. Hence the coils, once at the desired temperature, can easily be kept there.

The advantage of the somewhat complicated arrangement of copper bars will now be seen. We can, without withdrawing the coils 3 and 4 from their water boxes, and without in any way disturbing the other arrangements, *reverse* the position of the coils 3 and 4 on the bridge, by simply lifting up the legs half an inch, and changing the mercury cups into which they dip. Thus the legs of coil 3 are changed from cups *a* and *c* to *b* and *d*, and those of coil 4, from b' and d' to a' and c'. This exchange does not occupy more than a few seconds, and hence we can obtain the two readings necessary to give the difference of the resistance of the coils 3 and 4 when they are at different temperatures in a very short time. During this short time the temperatures of the two coils will not change perceptibly, protected as they are by an air jacket. In the ordinary form of straight bridge there is considerable trouble in exchanging the coils, because the water vessels have to be moved and the mercury cups re-adjusted, and all this time the coils are cooling, so that the two readings are never made under the same circumstances as regards temperature. Beginning, then, with all four coils at the same temperature, we take the difference between 3 and 4. To get them all at the same temperature, water from the town mains is allowed to circulate through the system for half an hour. At the end of this time the difference of 3 and 4 is taken, and several readings are taken at small intervals of time, to see if the temperatures are constant. This being done, the temperature of coil 4 is raised by the introduction of warm water, until it is about 15° above that of coil 3. It is best to raise the temperature about 20° above the other at first, and keep it there for twenty minutes, and then let it fall very slowly. In this way coil and water cool together, and an equilibrium of temperature is established between them. The difference between 3 and 4 is again taken, and from these two readings we have, as seen above, the mean variation co-efficient between the two temperatures. Professor Chrystal, in his report, threw out the suggestion that resistance coils should have a thermo-electric couple attached to them—one junction being buried in the heart of the paraffin surrounding the wire, and the other outside. This has been tried in some coils recently made, and proves a satisfactory method of ascertaining the equilibrium of temperature between the wire and the water.

Another source of error in the ordinary methods arises from uncertain or variable resistances at the mercury cups. It is important that the copper legs of the coil terminals should press very firmly against the tops of the copper pins on which the india-rubber tube cups are fixed. To ensure this, the plan adopted is to fasten on the coil legs an ebonite clamp; along the edge of the wooden promontory,

j, *h*, *i* (fig. 1) are put brass pins, *m*, and by means of steel spiral springs fixed to these, and attached to the clamps, the coil legs are pressed down very firmly. The ends of the pins which carry the india-rubber cups, and the ends of the coil-legs being well amalgamated, we get, when they are thus firmly pressed in contact, a very good joint, and one whose resistance is small and constant.

If the clamps are not used, then one leg may get lifted up a little, and thus a short length of mercury interposed, which leads to an error in reading.

5. *Example of a determination of the variation co-efficient of a coil.*—The whole resistance of the platinum-iridium wire is very nearly 0·0512 of an

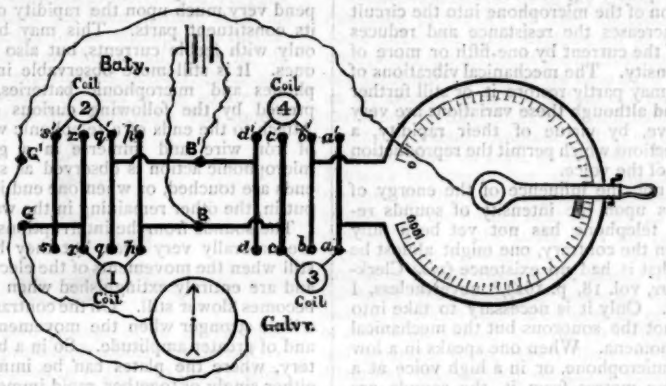


FIG. 4. DIAGRAM OF CONNECTIONS OF THE RESISTANCE BALANCE.

ohm, or not far from $\frac{1}{20}$ of an ohm, at about 15° C. As the whole length can be divided by the vernier into 10,000 parts, this gives as the value of one-tenth of a division, $\frac{1}{200000}$ of an ohm.

The unit in the following example is $\frac{1}{10}$ of a division :—

Two coils were compared—call them F and K. K is the coil whose variation co-efficient is required.

I. Difference of resistances of F and K, at 11° C.

	BRIDGE READING.		
Experiment 1	5.000	4.955	45
Do. 2	5.000	4.954	46
Do. 3	5.000	4.955	45

The first column gives the number of experiment; the second, the reading, with the coils F and K in one position; the third, when F and K are reversed on the balance; and the fourth gives the difference of their resistances at 11° C., in units, of the bridge wire.

II. Difference of resistance of F and K at 28·2° C.

Experiment 1	5.439	4.492	947
Do. 2	5.442	4.497	945
Do. 3	5.440	4.490	950

As before, the fourth column gives the difference of F and K at 28·2°. Taking the mean difference at 28·2° to be 947, and that at 11° to be 45 units, we have

$$\frac{947 - 45}{28{\cdot}2 - 11} = 52{\cdot}4 \text{ units}$$

as the mean variation co-efficient between 11° and 28°. Since F and K are approximately ohm coils, this gives us as the variation co-efficient of the coil K, ·0262 per cent. This coil is of platinum-silver wire. These three determinations occupied about an hour and a half, during which time many more readings were taken closely agreeing with the above.

In conclusion, I may state that this Resistance Balance has been constructed in the workshops of the School of Mechanical Engineering at Cambridge, under the direction of Prof. Stuart. Great care was taken in laying on the wire so as to avoid straining it in any way, and the performance of the instrument is consequently very satisfactory. I should also express the fact that this excellent performance is due to the supervising care of Prof. Stuart, who not only supplied several of the details of the construction, but aided by his valuable suggestions generally during the process of carrying out my rough designs into a practical form.

Cavendish Laboratory, Cambridge,
December, 1879.

NEW RESEARCHES ON THE THEORY OF THE MICROPHONE.

By DR. JULIAN OCHOROWICZ.

III.

WE have seen from the last article that for the transmission of articulate sounds, the number of points of contact, the variation of this number during the action of the instrument and the variations of resistance resulting therefrom should be as great as possible.

It is with a view to these conditions that the principal form of Hughes' microphone, Edison's

carbon telephone, MM. Pollard and Garnier's telephone transmitter with double graphite crayons, M. Hellesen's transmitter, &c., are arranged. The form here illustrated is typical of all the others, and I find it very useful in all microphonic experiments. It can be employed for transmitting speech, singing of different degrees of loudness, the sound of a watch placed near it, of a fly placed inside, the music of a piano, &c. The membrane is of caoutchouc, tightly strained, and provided with a thin strip of tin-foil, to unite the lower carbon with the binding screw. It is easy to see that during the vibration of the membrane a greater or less number of points of contact connect the two microphonic electrodes, thus producing variations of resistance. The introduction of the microphone into the circuit considerably increases the resistance and reduces the strength of the current by one-fifth or more of its original intensity. The mechanical vibrations of the membrane may partly restore it, or still further diminish it; and although these variations are very small, they give, by virtue of their rapidity, a number of inflections which permit the reproduction of every shade of the voice.

If I mistake not, the influence of the energy of sonorous waves upon the intensity of sounds received by the telephone has not yet been fully recognised. On the contrary, one might almost be led to believe that it had no existence (*vide* Clerk-Maxwell, *Nature*, vol. 18, p. 162),* nevertheless, I cannot doubt it. Only it is necessary to take into consideration not the sonorous but the mechanical part of the phenomena. When one speaks in a low voice near the microphone, or in a high voice at a distance of some metres from it, the sounds are more feeble than when spoken in a high voice or near it. A loud-ticking watch is heard better than a quiet one, &c. The limits of proportionality are very narrow, it is true, but the differences of resistance are also. Increasing the latter we increase the former.

The supposed independence of the sounds in the receiver of those actuating the transmitter is based on a fact parallel to the first, namely, that the limits of *distinct* articulation are much narrower than those of non-articulate sounds. *The definition* and clearness *of articulate sounds transmitted by the microphone are in inverse ratio of their intensity.* The intensity increases in proportion as the microphonic vibrations tend to completely interrupt the current, while at the same time the faculty of transmitting articulate sounds disappears.

And this is the chief difficulty in the way of amplifying sounds at will.

The intensity of the sounds attains its maximum when the interruptions of current become complete; but then they can no longer be articulate: this is why we hear better when the speaking is in the ordinary tone than when it is in a high tone.

The intensity is also in direct relation to the strength of the current, but this relation is still more limited than the above. The microphonic indications commence as soon as the current has sufficient strength to overcome the resistance of the microphone and to flow through it. It is the sounds of complete interruptions which first appear; they are very feeble, and their modulation is as yet impossible. If the intensity of the current be augmented, modulation attains its first degree, and the sound of a watch is clearly perceived. It becomes stronger as the intensity of the current takes a third step, and then speech becomes perceptible. Just as the current increases so the intensity of the sounds increases, but their articulation dies out. Proportionality obtains only with simple sounds which produce the complete interruption of the current, and until the noise of sparking blots them out.

I have made a further series of experiments which show that the phenomena of the microphone depend very much upon the rapidity of movement of its constituent parts. This may be verified not only with feeble currents, but also with powerful ones. It is still more observable in liquid microphones and microphonic batteries, and may be proved by the following curious experiment:—Attach to the ends of a telephonic wire two pieces of iron wire, and immerse in a glass of water: microphonic action is observed as soon as the two ends are touched, or when one end is drawn out or put in, the other remaining in the water.

The sounds from the interruptions of the current are naturally very weak, but they become weaker still when the movements of the electrode are slow, and are entirely extinguished when the movement becomes slower still. On the contrary they become a little stronger when the movements are quicker and of greater amplitude. So in a bichromate battery, where the plates can be immersed at will, either singly or together, rapid immersion produces sharp sounds, while a slow and gradual immersion produces no microphonic action, even when carried deeper, although the intensity of the current increases, and the galvanometer needle is more and more deflected.

Variations of resistance and of current-strength are, therefore, not of themselves sufficient to produce microphonic phenomena: it is necessary that they be *rapid*.

The microphone itself alters the timbre of the voice, and this in a variety of ways depending upon the position of its parts and their initial pressure. By touching with the finger the movable bar, we can change the timbre in several degrees, and even produce spontaneous sounds corresponding to a rumbling, breathing, or plaintive crying, and that without any external cause intervening. This curious phenomenon is due to imperceptible skipping and slipping of the movable part of the microphone under the influence of its own weight. This can be produced artificially by making the microphone so that this automatic slipping is facilitated, and by placing the movable piece so that it can fall automatically. These noises are often sufficiently loud to be heard throughout a room, which proves that they result from interruptions more or less complete.

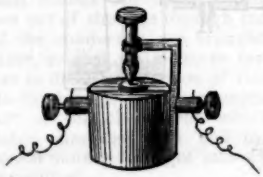
Simple sounds which result from a series of complete interruptions have always the same intensity and the same timbre, independently of the energy which produces them, but they vary in loudness according to the strength of the current.

The electric current being modified by the microphone throughout its length, and being competent to act at a distance by induction, it is not

* M. Wroblewski, professor in the University of Strasburg, even makes a law of this negation. "The energy of the sonorous waves has no relation to the intensity of the received sounds" (*Cosmos*, 1878, x. 398).

necessary to introduce the telephone into the circuit to hear the sounds. It is sufficient to bring it near to any point in the wire, microphone, or battery. For convenience it is better to use two telephones, and to bring one near while listening at the other. When, in place of the microphone, a coil with automatic make and break is introduced into the circuit, the transmitter telephone may be affected at a distance of a metre. If the telephone wires are joined directly to the secondary coil, the sounds, which may be heard throughout a room, are much louder than those of the interrupter itself. It is this sound which can be most easily heard in a microphone employed as a receiver.

This new and unexpected property of M. Hughes' marvellous instrument has been invoked as an insurmountable difficulty to the microphonic theory. "We cannot understand this at all," says M. du Moncel, citing the experiments of MM. Blyth and Hughes. Nevertheless, the fact is not so strange nor so new as was at first believed. The sounds



produced by the mere passage of an intermittent current have been profoundly studied by De la Rive in 1845* and by Beatson in 1846†. In the explanation it appears to me we must look to the various mechanical properties of the current. It is known that its passage influences the elasticity of its conductors (Vertheim), and although it cannot be strictly proved to lengthen the wire it traverses (Edlund), nevertheless experiments with the electric light (voltaic arc) show us that it effects a tearing away of carbon particles and carries them from one electrode to the other. We also know of the motion of liquid particles in the direction of a current, &c. It is therefore permissible to regard the electric current as a real *current* of water which carries with it in some fashion the material particles it encounters, especially when they are mobile. And if it is too weak to really carry them away, it nevertheless retains a tendency to do so which shows itself in almost imperceptible repulsions. And it is these repulsions which reproduce speech, being themselves produced by a current modulated by speech. We here find the same essential result as in the telephone—namely, a reciprocal transformation of cause into effect.

Sounds transmitted in this way are only perceptible when the solid conductor (a metal wire) is replaced by several separate and easily movable particles (the microphone); but it is easy to understand that they exist in a lesser degree at all points of the circuit. In proof of this it is only necessary to wind some insulated wire on a small wooden drum and to hold it against the ear. The loudness increases when a few pieces of iron are enclosed in the bobbin.

* *Comptes rendus*, xx. p. 1287. Pogg. Ann. lxv. 637.
† *Electro-Mag.* April, 1846.

Pushing the reduction of the telephone still farther, we can dispense with the receiving microphone and even the receiving coil by holding simple electrodes (metal plates or cylinders) against the temples. The intermittent current then passes by the head, and the dry skin here plays the same part as the sheets of paper in the singing condensers of MM. Varley and Pollard. An electric harp may also be constructed with fine wires close together, and this harp emits sounds when it is traversed by intermittent currents. In this case it is the air which plays the part of the bad conductor. Finally, a spiral of fine wire emits sounds under the influence of electro-dynamic attractions.

It only remains for us to say a word on the thermoscopic properties of the microphone. These come under the same explanation as served us to understand the action of the microphone when used as a transmitter; but, as we here have to deal with an electromotive action instead of a telephonic, the variations in the points of conductibility need no longer be *rapid*. Another and apparently contradictory distinction must be noticed. We know that Edison's microtasimeter shows effects altogether opposed to those of Hughes' thermoscopic microphone. In the former heat acts by an increase of conductivity; in the latter it is the reverse—heat increases the resistance. Why? Because in the first it is a *solid* body which dilates with heat and increases the *number of contacts*, while in the second, in which there are a number of small pieces of carbon juxtaposed, it is the *air*, which surrounds and separates them, which dilates most, and this dilatation necessarily produces a *diminution* of the number of contacts; the principle remains the same.

To recapitulate, it is impossible to discover in the microphone any new property of matter, or at any rate, in the direct action of sonorous waves on certainly low-conducting bodies. The microphone presents no analogy to the microscope, and it has nothing in common with selenium, though this does not make M. Hughes' invention any the less one of the greatest of our century.

The second theory, that of pressure, is but a superficial exposition of facts, and, in our idea, must be abandoned.—*La Lumière Electrique.*

LONG RANGE TELPHONING.—In a recent issue of this paper an exchange was credited with the statement that Mr. Robert Packer, "superintendent of the Pennsylvania Railroad," while travelling in Nebraska had conversed with his wife and friends at his home in Sayre, Pa., two thousand miles distant, by means of a telephone. We now learn on good authority that, though Mr. Packer's friends received his communication by telephone, it was not so sent by Mr. Packer. The message was sent from Nebraska to Mauch Chunk, Pa., by telegraph; thence it was telegraphed to the Sayre office of the Pennsylvania Canal and Railroad Company (of which Mr. Packer is superintendent), and from there it was transmitted to Mr. Packer's house by telephone—falling short of the newspaper report of the telephone's performance by some nineteen hundred and nine-nine miles and a fraction.—*Scientific American.*

GRAMME MACHINE FOR THE TRANSMISSION OF MOTIVE POWER.

THE importance of the important principle of the transmission of motive power to a distance is daily becoming more appreciated, and is making rapid strides towards taking the front rank in the engineering world. In our own country, at present, the subject is hardly likely to make very rapid progress, as the inland natural powers available for transmission are but very limited in number; when, however, the utilisation of the power of the tide, to which we have before referred, has been fairly taken in hand, then important results must certainly follow. In the meantime any advance made in the general question must excite great interest. The Gramme machine, of which we give illustrations, has been specially designed for the purpose of giving out the motive power transmitted to it in the shape of electricity, and four of which have been used with great success by M. Menier, on his farm at Noisiel, for driving a six-furrow Fowler plough, each machine developing 18 horse-power.

The arrangement of the whole machine is very solid, the frame being cast in one piece, and the armatures, which are four in number, are very firmly fixed to the frame and to the iron cases; the bobbins are large, and the collecting brushes, which are four in number, are securely held by binding, instead of being supplied laterally. The revolving bobbin is about 18 inches in diameter, and the same in depth.

The general details of the machine are self explanatory, and do not require description.

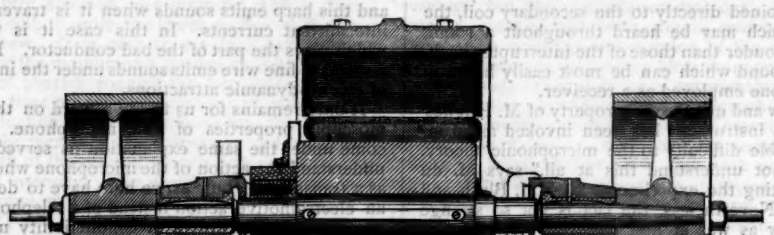


FIG. 1.—LONGITUDINAL SECTION.

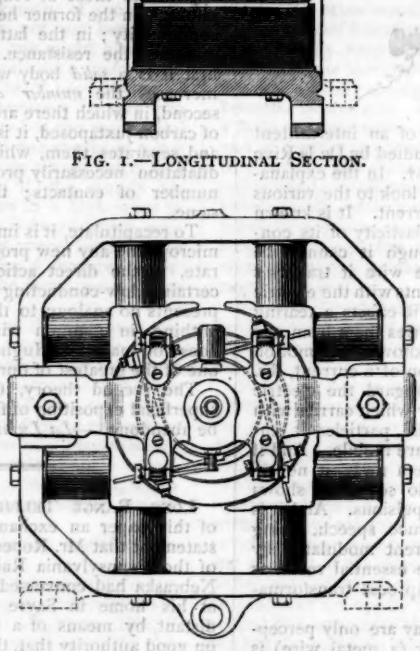


FIG. 2.—END ELEVATION.

LADD'S IMPROVED HOLTZ MACHINE.

THE ordinary form of Holtz machine, although a powerful generator of electricity when in good working order, is, nevertheless, uncertain in its action and somewhat cumbersome in form when of a large size. Mr. Ladd, of Beak Street, has greatly added to the value of the machine, without modifying its general construction, by constructing it with multiple plates, and enclosing the whole in an air-tight case, thus rendering it insensible to climatic changes, which so powerfully affect its good working. We have recently had an opportunity of inspecting one of these improved machines, and can testify to its extreme portability and efficiency. The glass case in which the whole is enclosed, air-tight, is but 2 feet 4 inches long, 14 inches broad, and 20 inches deep. It contains 6 fixed glass plates, 15 inches in diameter, and 6 revolving ebonite discs, 14 inches in diameter. The handle, which rotates the latter by multiplying pullies, passes out of the case through india rubber packing, and the conductors are brought out in a similar manner, so that no moisture can possibly enter the case to disturb the action of the machine.

The Holtz machine is very convenient for exhibiting most of the phenomena which usually require a large size induction coil to produce, whilst it is much more readily got into action as no batteries are required.

MACHINERY EMPLOYED IN THE LAYING OF THE NEW MARSEILLES-ALGIERS CABLE.

IN the paper lately read by Mr. March Webb, before the Society of Telegraph Engineers, on "Operations connected with the laying of the New Marseilles-Algiers Cable," full illustrated descriptions were given of the appliances used in connection with the work. Through the kindness of Mr. Webb we are able to give an illustrated description of one of the most important pieces of mechanism employed on board the *Dacia*, which was used in connection with the "paying-out" operations.

The machinery used in connection with the paying-out of a cable consists, first, of "the holding-back" gear, through which the cable passes immediately after it leaves the tanks; from this gear the cable next passes round the "paying-out drum," and thence through the dynamometer and over the stern sheave into the sea.

The "holding-back" gear is an important part of the machinery, as its function is first of all to steady the cable as it comes out of the tanks, and secondly to prevent its overrunning and fouling as it passes on to the paying-out drum. The ordinary form of "holding back" gear consists of four or five V sheaves, one in front of the other in a straight line; the cable lies and is pressed down in the V grooves of these sheaves by "jockey pulleys." Each of the V sheaves is provided with a brake. Such an arrangement practically gives but little holding-back power, and even if the brakes be applied so as to completely stop the turning of the V sheaves, the cable, when it has a heavy strain upon it, may become difficult to control, especially if it chances to slip on the paying-out drum, as is the case sometimes. The "holding-back" gear employed on board the *Dacia*, and which was used in the recent Marseilles-Algiers Cable Expedition, is the most efficient piece of machinery for the purpose yet devised, and it is extremely simple in its construction. Fig. 1 shows a plan of the arrangement.

A A A are iron segments firmly screwed on to a balk of timber. B B are iron segments which can be worked backwards or forwards by screws which are moved by bevilled wheels D D attached to the shaft E, the latter being provided with a hand-wheel F for turning the same.

The pressure and consequent friction which can be applied to the cable by increasing or diminishing the distance between the movable segments B B and fixed ones A A A can be regulated to any required degree by turning the wheel F; and thus any holding-back power required can be obtained; or by screwing the segments completely back the cable can pass perfectly freely. (*To be continued.*)

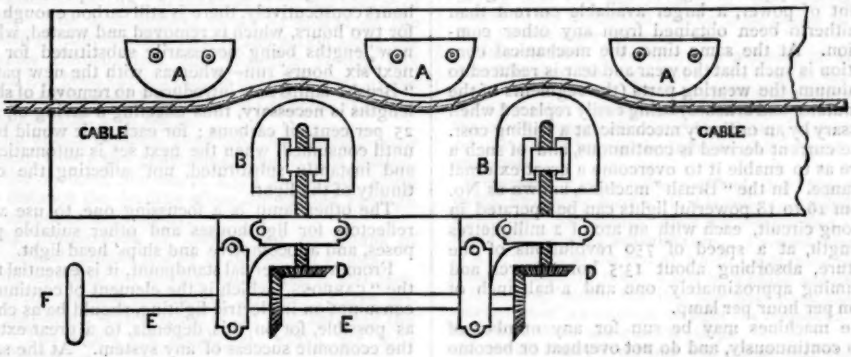


FIG. 1.

THE BRUSH SYSTEM OF ELECTRIC LIGHTING.

THIS system of electric lighting, an illustrated description of which was given in the number of the TELEGRAPHIC JOURNAL for Jan. 15, 1879, has lately been introduced into England by the Anglo-American Electric Light Co. (Limited), of Hatton-garden, London, E.C. An exhibition of this light took place at the company's premises on Tuesday, Dec. 23rd, in the presence of representatives of the press and others interested in the subject.

The introducers of this system claim that the drawbacks of expense, uncertainty, and complicated mechanism, which have hitherto stood in the way of an extended application of the electric light, are overcome, and economy, constancy, and simplicity secured. During the past year the system has been adopted very largely in the United States, and with most satisfactory results, in various institutions, hotels, colleges, shops, chemical manufactories, iron and steel works, worsted, linen, and cotton mills, dry goods stores, printing offices, parks, steamers, harbours, and mines, for all of which it has been found not only available, but advantageous and economical. At present the manufacturers there are unable to keep pace with the orders for the machines.

The system embodies important improvements and advantages in the three essentials necessary for electric lighting, viz. :—The generator or dynamo-electric machine ; the lamps or carbon regulators ; and the carbon.

The "Brush" DYNAMO MACHINES are made in several sizes, capable of operating from 1 to 16 or even more lights in *a single circuit*, which may be of 10 or 12 miles length if required. In construction, the machines differ essentially from all others, both in the armature, the arrangements of the field magnets, and the commutator ; as will be seen by reference to the article in the Journal previously referred to, also the mode of connections adopted is novel, thereby producing, it is claimed, from a given amount of power, a larger available current than has hitherto been obtained from any other combination. At the same time, the mechanical construction is such that the wear and tear is reduced to a minimum, the wearing parts (the segments of the commutator and brushes) being easily replaced when necessary by an ordinary mechanic, at a trifling cost.

The current derived is continuous, and of such a nature as to enable it to overcome a great external resistance. In the "Brush" machine, known as No. 7, from 16 to 18 powerful lights can be operated in one long circuit, each with an arc of 2 millimetres in length, at a speed of 750 revolutions of the armature, absorbing about 13·5 horse-power, and consuming approximately one and a-half inch of carbon per hour per lamp.

The machines may be run for any number of hours continuously, and do not overheat or become less effective through continued use ; further, by a special regulating attachment, any smaller number of lights than the maximum that may be required can be employed, absorbing proportionately less power.

The "Brush" LAMPS are very simple in construction, thus ensuring ease of management, safety against internal derangement, and regularity of working. Those exhibited on the 23rd were very similar to the one illustrated in the Journal ; but ordinary double magnets were employed in the place of the single bobbin shown in the illustration. By means of the magnetic control and automatic "cut off," each lamp, though in continuous circuit with many others, is independent in its working. Thus a mean length of arc, and equality of light, and consumption of carbon is always maintained. The "cut off" effectually guards against all dangers of general extinction ; should any one lamp in the circuit be thrown out by consumption of carbon or other cause, the remainder are not affected. In order to produce steadiness in the movement of the carbon the holder of the latter is connected to a small piston fitting loosely in a cylinder filled with glycerine, this damps the oscillations and prevents jerks.

The "factory, or general purpose lamp," consists of a strong rectangular iron frame, containing the regulator, the carbon holders, and support for the globe, and is placed in proper position, and at the same time in electrical connection with the other circuit lamps and generator, by simply *hanging* it up to its board, and thus doing away with all loose wires and screw terminals. These lamps are constructed to burn about eight hours without renewal of carbon. The "double rod" lamps are a modification of the above, and are especially useful when a light is required for a longer period than eight hours continuously. These lamps contain two sets of carbon holders and carbon rods, ingeniously constructed with a single regulator, which only allows one pair of carbons to burn at once, but instantaneously and automatically throws the second pair into circuit when the first are consumed. By means of these double rod lamps, a system of lights may be maintained in continuous operation for sixteen hours without requiring any attention ; or, by introducing three rods and three sets of carbons, for twenty-four hours. It is obvious that the economical advantages of such an arrangement are very great in preventing waste or short lengths of carbon ; for instance, in eight-hour lamps of other systems, when the lights are required, say, for periods of six hours consecutively, there is still carbon enough left for two hours, which is removed and wasted, whole new lengths being necessarily substituted for the next six hours' run—whereas with the new patent "Brush" lamps now introduced no removal of short lengths is necessary, thus effecting a saving of, say, 25 per cent. of carbons ; for each pair would burn until consumed, when the next set is automatically and instantly substituted, not affecting the continuity of the light.

The other lamp is a focussing one, to use with reflectors for lighthouses and other suitable purposes, and a locomotive and ships' head light.

From a commercial standpoint, it is essential that the "CARBONS," which is the element of continuous consumption in electric lighting, should be as cheap as possible, for on this depends, to a great extent, the economic success of any system. At the same time, it is most important, in order to ensure a good light, that the carbon should be of great purity and uniformity. The "Brush" carbon is manufactured by a process which ensures these conditions. Recent analysis made in this country proves that it contains only a ½ per cent of foreign matter, as compared with from 2 to 3 per cent. contained in the very best samples of any other kinds that could be

produced. The uniformity is such, that in repeated observations, in a series of 16 lamps burning together at various times for many hours, no unequal consumption in any one of the lamps could be detected. The price at which it can be supplied is 4d. per foot.

From the peculiar construction of the Brush machines a large number of lights may be worked at a long distance from the dynamo-electric machine, with a very small loss of power. In an experiment made, the resistance in the circuit was suddenly changed from that equal to 1½ mile of conducting wire to a resistance equal to 250 feet only, and the effect on the 16 lights was barely appreciable. One pair of conductors only is required for all lamps, no matter what their number may be, and the loss due to these conductors falls, not on each lamp, but upon the whole circuit.

The experiments made on Dec. 23rd were very successful, the light being remarkable for its steadiness. Each of the lights, according to Mr. Ladd, had an intensity equal to 960 standard candles, the photometer being placed on a level with each lamp. With the lamp elevated so as to cause the rays to fall with an incidence of about 45°, the power is considerably greater, perhaps as much as 20,000 candles.

The engine employed to drive the dynamo machine was supplied and manufactured by Messrs. Wallis and Stevens, of Basingstoke, and worked with remarkable steadiness.

THE ELECTRIC LIGHT AT THE VICTORIA STATION OF THE METROPOLITAN RAILWAY.

ON Monday, Dec. 15, the first public trial was made of an electric lighting system for the illumination of the Victoria Station of the Metropolitan District Railway. This trial, which was a great success, was more particularly of interest in consequence of the distance of the illumination from the source of light. The arrangement is an extension of the system of illumination now in full action along the Thames Embankment and Waterloo Bridge, and which has been carried out, as is well known, by the Société Générale d'Electricité, of Paris, the engineer of which is M. J. A. Berly.

The actual distance between the Charing-cross Station, where the generating apparatus is located, and the Victoria Station, is 2,373 yards, and along this distance the leading wires are carried through the tunnel of the railway.

The illumination is carried out by means of Jablochkoff candles placed in opalescent globes.

The length of the station illuminated is 300 feet, its width 50 feet, and height 40 feet. There are two platforms, with a space of 20 feet between the two. Ten lights are employed, which are thus distributed :—

Five on the down platform, dividing the length in equal distances, four on the up platform, alternating with the five of the down line, and one central, situated over the middle of the bridge or passage connecting the up and down lines. Each light is about 13 feet above the ground, and all are suspended from the iron roof of the station. The lamps are of the same power and description as those used on the Thames Embankment, Waterloo Bridge, and elsewhere. They are enclosed in 16 inch opal globes. The same steam engine which is maintaining the 40 lights on the Thames Embankment and the 10 on Waterloo Bridge, is employed to produce the lights. The engine is, therefore, now maintaining 60 lights altogether.

The distance between the two stations of Charing-cross and Victoria, as we stated, is 2,373 yards, or 1·354 mile; but the length of wire between the two stations, owing to the curves and losses necessarily attending the laying, connecting, and fixing, amounts to about 1·65 mile; the whole circuit being, therefore, of a length equal to 3·30 miles.

The 10 lights are on two circuits, and maintained by the two spare circuits of the Gramme machine feeding the 10 lights on the Waterloo Bridge.

The leading wire is of the same description as that throughout the Thames Embankment, viz., a cable of seven strands of copper wire well insulated. The last electric lamp at Blackfriars Bridge is one mile from Charing-cross; the frontage thus actually covered is 2·65 miles.

A fourth 20-light Gramme machine has just been erected at the Charing-cross centre, and a trial of 80 lights, worked by a Ransomes, Sims, and Head's 20 nominal horse-power engine, will shortly take place.

Correspondence.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—I read in your Journal of the 1st December an account of a lecture delivered by Mr. W. Lant Carpenter on the daily practical applications of electricity in the United States.

In this lecture Mr. Carpenter is reported to state that having interviewed Mr. Edison at Menlo Park, and having seen his sub-division of the electric light, comes to the conclusion that he is no nearer to it now than he was some two years ago.

Unfortunately I had not the pleasure of knowing Mr. Edison so long ago, but upon a visit to the States about eight months ago I made the acquaintance of Mr. Datchelor, who was kind enough to post me up in the numberless inventions of Mr. Edison, including the sub-division of the electric light, to which I paid special attention.

Personally I was quite satisfied that Mr. Edison would ultimately succeed in his object, and it is only within the last month, upon my second visit, that I made Mr. Edison's acquaintance. I visited him twice in a fortnight, at the end of which I was more satisfied than ever that the result would be a grand success.

It is only within the last few days that the news reaches us of an attempt to light the houses in Menlo Park with these new electric lamps.

I should fancy every one will admit that this is a great move forward in this sub-division, and I hope will be sufficient to satisfy Mr. Carpenter that his statement is somewhat incorrect and misleading.

I am, yours, &c.,

CHARLES LEVER.

Bowdon, Cheshire.

[We cannot see that our correspondent in his letter has answered Dr. Carpenter's remarks on the subject; he, like Dr. Carpenter, has merely stated a conclusion

drawn from his own impressions, no *facts* are stated, except that an *attempt* (the italics are our own) has been made to light the houses at Menlo Park. This hardly amounts to a solution of the problem, we think, nor do we see how it can be characterised as a "great move forward in this sub-division."—ED. TEL. JOUR.]

TRIALS OF THE JABLOCHKOFF AND WERDEMANN ELECTRIC LIGHTS IN PARIS.

SIR,—In your issue of the 15th inst., under above head, you have shown, I think, rather too great bias in favour of the Werdemann light; but as you have ever evinced a desire to act fairly and impartially, I will put before you one or two points that suggest themselves.

M. Werdemann was to have lit the Mansion House and Exchange Place a year ago. Why has *nil* come of this? * * * * *

For the first time we learn that the system Werdemann was steady and silent, while its rival was noisy; also, that in the trial M. Werdemann used no globes to his lights, "thus to show the natural colour of the same." Surely this remark is unnecessary, as doubtless those superintending arranged details of the trial.

In the matter of the power required for each light, how unfair is the subject placed before the general reader. Twelve Werdemann lamps required, your article says, 6 horse-power or half horse-power for a light, while the Jablochkoff system took 12 horse-power for eight lamps, or 1½ to each light. No mention is made of the power of light, leaving it to be believed that the Jablochkoff required 1½ horse-power to each light. Whereas the fact is that one of them of quite 300 candles requires little over a ¼ horse-power, while a Werdemann necessitates for a lamp of only 30 gas jets ½ a horse-power.

As the result of this experiment is in the hands of M. Garnier and M. Vaucorbeil, the Director of the Opera, it would, I think, have been better to have awaited their report before endeavouring to lead the public mind.

Whether the Werdemann system requires quantity currents as against intensity in the case of the Jablochkoff matters really very little; the former is a very pretty little light if well regulated; suitable, no doubt, for certain work: the latter can do anything; has proved its adaptability for interiors, shops, or warehouses, for street lighting, or for railway stations, near or distant from the seat of electric power, and by its last step, that, whether by intensity currents or not, it can light at nearly two miles from the engines, steam and electric, and without any regulator or apparatus of any kind, a large station; and I have no doubt whatever, that when the system is worked on a large scale, it will be found to contrast, as to *cost*, most favourably with any system of electric lighting, and even with gas itself.

Your obedient servant,
ELECTRON.

Junior Carlton Club,
December 23rd, 1879.

[We have received another important letter on this subject, which arrived too late for publication in the present number; it will, however, appear in our next issue.—ED. TEL. JOUR.]

THE cable between St. Thomas and St. Kitts is interrupted, and as the cables between Antigua and Guadeloupe, and between St. Croix and Trinidad are not yet repaired, there is at present no telegraphic communication with St. Kitts, Antigua, Guadaloupe, Dominica, Martinique, St. Lucia, St. Vincent, Barbadoes, Grenada, Trinidad, Demerara, and Berbice.

Notes.

TELEPHONIC EXCHANGES.—The Lancashire Telephonic Exchange Company (Limited), are busily engaged establishing "Exchanges" in the principal manufacturing towns of Lancashire. Already the company have exchanges at Liverpool and Manchester, and the subscribers at these places are increasing almost daily. At present there are 120 subscribers in Manchester and somewhat more at Liverpool. It is astonishing how popular these exchanges are now becoming, and people wonder why they were not introduced long since. Manchester was shrouded in a thick fog on Monday, the 8th ult., but thanks to the telephone, merchants and others were able to arrange their business transactions without leaving their offices. There was some fear when the telephone was first brought under public notice that it would become simply a wonderful scientific toy, but there can now be no doubt that it will be utilised to an enormous extent, and that it will replace very largely the instruments at present employed on private telegraph lines.

THE CAPE CABLE.—The section of the Cape Cable between Aden and Zanzibar has been laid, thus connecting telegraphically the Cape Colony with the rest of the world.

ROYAL INSTITUTION LECTURE.—The Friday evening lectures at the Royal Institution, before Easter, will include a lecture by Professor Dewar, on "Studies on the Electric Art," on January 16th, and a lecture by Mr. W. H. Preece, on "Wheatstone's Telegraphic Achievements," on February 13th. Dr. C. W. Siemens will lecture on the 12th March.

THE FRENCH ATLANTIC CABLE.—The French Cable, the main portion of which has recently been laid, will have a total length of 3,363 knots. Of this distance, the cable from Brest to St. Pierre, Newfoundland, which has been laid, is 2,395 knots in length. The portion between St. Pierre and Cape Cod, Massachusetts, which has also been laid, is 860 knots long. From Cape Cod to New York the messages will be transmitted by an overland wire, the property of the Company. Another portion of cable, 270 knots in length, has just been laid between St. Pierre and Nova Scotia. It was not intended to finish this portion during the present year, but the rapidity with which it has been constructed has enabled it to be completed. The completion of the total length of 3,663 knots will be effected when the last link, 138 knots in length, is laid between Brest and the Land's End. The completion of the main portion of the cable was heralded by the usual complimentary messages.

REMARKABLE ELECTRIC PHENOMENON.—At the commencement of a violent snowstorm, the author perceived little luminous tufts at the end of the steel rods of his umbrella, and heard a sound like the humming of an insect. On approaching his hand to one of the lights he felt a slight shock in the first two joints, and the light disappeared.—*E. Lamarre, in "Comptes Rendus."*

THE ABERMAWR-WEXFORD CABLE.—Operations in connection with the repair of the Abermawr-Wexford 4-wire cable, belonging to the Postal Telegraph Department, and which was broken a short time ago, have already been commenced. It has been found necessary to renew entirely a portion of this cable. The repairs will be completed early in the present month.

POST OFFICE TELEGRAPHS.—The Postal Telegraph receipts for the months of October and November last

year have exceeded those of the corresponding months in the previous year by no less than £36,378, or nearly 17 per cent.

THE Post Office and Telegraph departments of Queensland are being amalgamated.

UNDERGROUND TELEGRAPHS IN FRANCE. — M. Cochery, the Minister of Posts and Telegraphs in France, recently applied to the Government for a credit of 8,000,000f. for the establishment of subterranean telegraph wires along some of the main trunk lines, to take the place of the existing aërial lines, should the latter become incapacitated by the weather, or any other cause. The total length it is proposed at present to lay is 965 kilometres.

THE BLAKE AND THE EDISON TELEPHONIC TRANSMITTERS.—In a letter to the *Scientific American*, Mr. T. D. Lockwood, of Boston, U.S., says:—

"An attempt is now made to induce the public to believe that Mr. Edison is also the inventor of the only really successful microphonic transmitter ever produced. I allude to that invented by Mr. Francis Blake, of Newton Lower Falls, Mass., and described in your issue under the date of November 1.

"Wherein the similarity between the Blake and the Edison transmitters lies, it is difficult for one acquainted with both to say, save in the fact that both are used in combination with an induction coil, the secondary circuit of which is a part of the main line.

"I have examined Mr. Prescott's account of Mr. Edison's inertia telephone, and find it totally different, both in action and principle, from any microphone.

"It appears, however, from the article in question, that Mr. Edison's latest transmitter, described also in the *Scientific American* a few weeks since, is also like the 'old invention,' in principle. If so, it is a query why the Western Union Company did not bring out this superior instrument instead of the carbon telephone, when the latter was beaten everywhere by the Blake transmitter. The fact really is that the Western Union tried to imitate the Blake transmitter at different times since its introduction, a year since, and could never make the imitations work, simply because the Blake transmitter has a few technical points on which its success depends, and which are only known to the electricians of the National Bell Telephone Company.

"Mr. Prescott states in his book, and it is found to be true in practice, that although many substances may be used as a conducting medium for varying resistances in the Edison transmitter, lampblack is the best; *per contra*, lampblack is not used in the Blake transmitter at all, the substance used being invariably very hard gas carbon, besides which Mr. Edison himself states in his patent 203,016, that unmixed carbon is not adapted for use in his transmitter.

"The article we have alluded to as in your last issue, in its second paragraph states that there is 'nothing delicate or fine about the construction' of the Blake transmitter. In the third paragraph we find the words, 'this casting supports two delicate springs,' &c. One of the main features in this transmitter is the delicacy of the adjustment obtained by means of the casting, which is perpendicularly across the inside of the diaphragm, and the screw in its lower end. In conclusion, I desire to say that no cavilling spirit dictates these remarks, but simply a desire for justice to the Blake transmitter, it inventor, and perfecters."

a lecture delivered at Berlin, on "Electricity in Service of Life," Dr. Werner-Siemens spoke of the problem of the electric transmission of power to a distance. He stated that two cases of the kind existed in the city; in one case looms were driven, and in the other a small locomotive. He also insisted upon the value of electricity for metallurgical purposes, and thought that the solar rays may by-and-by furnish all necessary fuel through the agency of the electric current.

THE METROPOLITAN FIRE BRIGADE TELEGRAPHS.—At a recent meeting of the Metropolitan Board of Works, the Fire Brigade Committee stated that their attention had been called to the necessity of improving the telegraphic communication between some of the fire stations. Delay and inconvenience arose from the fact that some of the outlying stations were not in direct communication with the chief office of the district. It was resolved that immediate steps, at a cost of £225, be taken for the purpose of remedying the difficulty.

THE TIDE AS A MOTIVE POWER.—At the fortnightly meeting of the Liverpool Engineering Society, Mr Arthur Pates, of Bradford, read a paper on the "Utilisation of the Tides." In the course of it he remarked he believed that the "age of steam" had reached i zenith, and the "age of electricity" had dawned. Th author illustrated the paper by drawings, which were lucidly described, showing the proposed method of utilising the power of the tides, and by a table giving the approximate cost of such works.

THE TELEPHONE IN BURTON.—Messrs. Bass & Co., says the *Burton Chronicle*, now possess the most unique and comprehensive telephone department of any private firm in England. A central office has been established on the system of the public telephone exchanges at work in America, and more recently in London, Sheffield, and elsewhere. The wires, some of them nearly two miles in length, twelve in number, and springing from the offices of heads of departments, are terminated in the central office. In this office is also placed a very ingenious yet simple "switchboard," which provides the means of putting the ends of the wires in electrical connection. A series of brass "shutters" are attached to the switchboard, each shutter being engraven with the name of the office with which it is connected. When a distant office desires communication, the shutter on that particular wire falls open. In a moment the operator in the central office, by the insertion of a brass plug, is informed the name of the other office with which communication is wanted. The insertion of another brass plug completes the joining of the two wires together, and the two offices, although miles away, are in oral communication with each other; the whole operation of putting them through having occupied three or four seconds. This vast concern now transacts its business, although covering so much ground, with the ease and freedom of being placed in one large building. It only remains for us to add that the voice of the speaker at the most distant office was as plain and as familiar as if we were face to face, and the extreme sensitiveness of the apparatus was demonstrated by the fact that we heard whispering and the ticking of a watch with remarkable distinctness. A clerk is employed at the central office from 7 a.m. to 6 p.m. simply to attend to the telephone. The whole of the work in connection with the system has been carried out by Messrs. Tasker, Sons, and Co., of Sheffield.

OPTICAL TELEGRAPHY.—The French Minister of War has published regulations for organising optical telegraphy in time of peace. Several places on the French frontier are to be connected by posts, and apparatus are to be manœuvred by trained persons,

who will make reports of communications sent or received. This new service is to be placed under the supervision of the Director of Aërial Communications, who already has command of the balloonists and colombophiles for carrier pigeons.

WESTERN UNION TELEGRAPH COMPANY.—At the close of the year, ending June 30, 1879, the Western Union Telegraph Company had 82,987 miles of line, 211,566 miles of wire, and 8,534 offices. At the close of the year ending June 30, 1869, the corresponding totals were 52,099 miles of line, 104,584 miles of wire, and 3,607 offices. In the year ending June 30, 1879, the company forwarded 25,070,106 messages as compared with 7,934,933 messages in the year ending June 30, 1869.

SAWYER'S ELECTRIC LAMP.—A new electric lamp was recently exhibited in operation at the factory of Arnoux & Hochhausen, manufacturers of electrical lighting apparatus, at Nos. 2 and 4, Howard Street, New York. The lamp is the device of Mr. Charles Sawyer, who exhibited an apparatus called the "Sawyer-Man Lamp" about a year ago. The light of this lamp was produced by the heating to a white heat of a slender, short pencil of carbon, supported in an hermetically sealed glass tube. This tube was filled with nitrogen gas, and contained at its base a preparation which the inventors claimed would prevent the destruction of the carbon pencil. The lamp exhibited is a modification of the Werdemann and the Sawyer-Man lamps. The pencil is eight inches long, is hermetically sealed in a glass tube containing nitrogen, and is fed upward, like the pencil of Werdemann's lamp. Mr. Sawyer claimed that the pencil would need to be fed upward, one-sixteenth to one thirty-second of an inch, once during a period of from nine to fourteen hours, and that the pencil would, therefore, supply light for about 1,500 continuous hours. This result, Mr. Sawyer said, was due to an electrical generator of his own design. The total cost of materials for a year's constant use of the lamp would be 12 cents. Three lamps were exhibited in one circuit, and each gave a good light. Any one light may be extinguished while the others remain unaffected. A company, to be called the Eastern Manufacturing Company, is to be organised in New York for the purpose of introducing the new apparatus. Mr. Sawyer said it is proposed at first to provide sets of lamps consisting of from two to six lamps, each set to be accompanied with an electrical generator and all necessary apparatus. The lamp is designed to be used in the place of gas light, and Mr. Sawyer claims that he has accomplished the necessary sub-division of the light.

THE TELEPHONE AT BIRMINGHAM.—Augustus Westwood & Co., telegraph engineers, of West Bromwich, have erected five lines of wire for Messrs. W. and T. Avery, Birmingham (the eminent scale makers), on which they are using Bell's telephone. The success of the instrument is so great that the firm are in treaty with Messrs. Westwood to erect a line of wire between their works at Birmingham and Ryder's Green, a distance of 10¼ miles.

A STORM DETECTOR.—Professor A. Mayer, of the Steven's Institute, U.S., records that while a thunderstorm was raging at so great a distance off that only the illumination of the clouds told when a flash occurred, he attached one wire of a galvanometer to the water-pipes and the other to the gas-pipes of his house, thus connecting in metallic current a vast system of metallic conductors stretching all over the city. Whenever a flash occurred he states that the galvanometer needle was deflected 10° to 20°. The two occurrences were simultaneous, so far as could be determined. The storm was 12 miles distant, and the conclusion drawn was that "at least 500 square miles of the earth's surface had its electrical condition changed at each flash of the lightning."

Proceedings of Societies.

PHYSICAL SOCIETY.—DECEMBER 13th, 1879.

Prof. W. G. ADAMS in the Chair.

New Members—Mr. J. H. POYNTING, Mr. R. T. GLAZEWOOD, Dr. R. C. SHETTLE, Prof. ROWLAND, Mr. JOHN GRAY, D. Sc., Mr. H. R. BROOK, Mr. E. B. SARGENT, Mr. E. PATERSON.

"On the Graduation of the Sonometer," by Mr. J. H. Poynting, Trinity College.

The author had endeavoured to reduce the present arbitrary readings of the sonometer of Prof. Hughes to absolute measure by adopting the formula given in Maxwell's *Electricity*, vol. ii., chap. xiv., to the induction of two circular coils on the same axis separated by a distance greater than the radii of the coil, on a third coil intermediate. By applying the formula thus obtained to the results of Prof. Hughes for different metals, he finds that either the electric resistance of metals as given in the tables is not the same as the resistances of the metals as employed by Prof. Hughes, or that the induction effect of the balance or sonometer is not proportional to the conductivity of the metal.

Prof. AYRTON reminded the society that, at a former meeting, he had shown mathematically that the effect was not proportional to the conductivity but to an exponential function of the conductivity. W. CHANDLER ROBERTS, F.R.S., stated that Prof. Hughes did not profess that the metals used by him to obtain his results were pure. Prof. ADAMS mentioned that Prof. Hughes had shown that the effect was dependent on other conditions than the mere purity of the metal.

Dr. G. A. FLEMING, St. John's College, Cambridge, exhibited and described a new form of Wheatstone balance, designed principally for comparing the B. A. units of resistance deposited in the Cavendish Laboratory. The divided resistance is a circular platinum-iridium wire, and an arm fitted with a contact at its extremity revolves round after the manner of circular resistance coils, thus altering the ratio of the divided resistances. The contact is a knife-edge of platinum, and it is made and broken by hand like a key. A [illegible] of ingenious copper mercury-cups are fitted to the balance so as to permit of two coils being compared at any temperature with great exactness by the method suggested by Prof. Foster and adopted by Prof. Chrystal of Cambridge. This consists in exchanging the positions of the units on the balance and observing the difference in the results. By Dr. Fleming's arrangement this exchange can be effected without removing the coils from the heating apparatus in which they are placed or otherwise altering their conditions. The mercury contact-cups, and the heating cans were also improved by Dr. Fleming for the purpose of facilitating accuracy of results.*

Prof. PERRY described a Dispersion Photometer devised by himself and Prof. AYRTON, for the purpose of comparing intense lights, such as the electric, with a standard candle, without taking up much room in order to put the stronger light a distance from the screen proper, to give an illumination equal to that of the candle.

* A full illustrated description of this Balance is given on page 3 of this Journal.

To reduce the distance of the stronger light from the screen, the authors had inserted a lens in the track of the beam, so as to disperse the beam to a degree which could be determined by an easy formula. Thus by artificially diluting the powerful beam they could compare it with the feebler beam, from the standard light, in a shorter space. For an electric light of 6,400 candles only 8 feet need be required by the new plan, instead of 80 feet by the unassisted method.

Dr. JOHN HOPKINSON, F.R.S., stated that he had actually used the same method for some months past in his electric light experiments. He recommended a plano-convex lens as the best to use; and suggested that the focal length should be calculated. He thought that the error due to absorption could easily be obviated.

Prof. AYRTON then described a method by which Prof. PERRY and he had determined the value of g, or the co-efficient of gravity, at the Imperial Engineering College, Tokio, Japan, by means of pendulums. Their result is 980·06; and calculation from the position of the place makes it 979·8.

An improved form of Spherometer, designed by Mr. W. GOOLDEN, and made by Mr. ADAM HILGAR, was exhibited to the meeting. The frame is of aluminium, combining lightness and rigidity; the legs and screws of hard steel. The screw carries a drum, divided into 1,000 parts, and the instrument gives a reading to the $\frac{1}{100000}$ of an inch by the usual method of touch. Increased sensitiveness is got by employing a galvanometer to indicate the contact of the middle pointer with the surface. By this means it is made correct to $\frac{1}{100000}$ of an inch.

New Patents—1879.

5009. "Friction telephones; or, electromotographs." J. IMRAY. (Communicated by J. F. Bailey.) Dated Dec. 6. Complete.

5044. "Improvements in wire drawing and apparatus therefor." J. IMRAY. (Communicated by P. Muhlbacher.) Dated Dec. 9.

5045. "Inclinatoriums; or, dipping azimuth compasses." J. IMRAY. (Communicated by J. Peichl.) Dated Dec. 9.

5078. "Improvements in, and relating to, electrical signal apparatus." W. R. LAKE. (Communicated by F. Blake.) Dated Dec. 11.

5085. "Dynamo electric machines, and electromotive engines." W. L. WISE. (Communicated by E. [illegible].) Dated Dec. 11.

5114. "Improved methods of, and apparatus for, facilitating telephonic communication." W. R. LAKE. (Communicated by M. D. and T. A. Connolly and T. J. McTighe.) Dated Dec. 13.

5119. "Electric telegraphs." SIR J. ANDERSON and F. S. HAREGOOD. Dated Dec. 13.

5126. "Electric signalling apparatus to be used in the loading and discharging of ships." W. WHITE. Dated Dec. 15.

5127. "Improvements in electric lamps, and in the method of manufacturing the same." T. A. EDISON. Dated Dec. 15.

5149. "Telephones and their connections." J. IMRAY. (Communicated by J. F. Bailey.) Dated Dec. 16. Complete.

5153. "Signal buoys." E. E. MANN. Dated Dec. 16.

5156. "Electric light regulators." S. PITT. (Communicated by C. E. Scribner.) Dated Dec. 16.

5157. "Magneto-electric machines and electric light apparatus." H. F. JOEL. Dated Dec. 16.

5167. "Safety alarm signalling apparatus to be used in connection with steam boilers." W. WHITE. Dated Dec. 17.

5175. "An improved mode of insulating mariners' compasses." A. W. L. REDDIE. (Communicated by J. B. Siccardi.) Dated Dec. 17.

5196. "Apparatus for ringing alarm bells on floating buoys at sea or in harbours." S. PITT. (Communicated by H. Brown.) Dated Dec. 19. Complete.

5206. "Improvements in, and connected with, electric lamps." G. G. ANDRÉ. Dated Dec. 19.

5219. "Galvanic Batteries." T. COAD. Dated Dec. 20.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1879.

1635. "Electric light apparatus." JAMES MCKENZIE, of the firm of Strode and Company. Dated April 25. Relates to improvements in apparatus for governing the distance between the points of the electrodes, or carbons of electric lamps, where they are arranged vertically, or opposite to each other.

1652. "Improvements in, and relating to, printing telegraph apparatus." WILLIAM ROBERT LAKE. (A Communication from abroad, by Casimir Hayet, of Paris.) Dated April 26. 8d. This invention consists of modifications of the ordinary dial apparatus. In order to adapt it for printing, it is necessary that the manipulator shall be an invertor, and the receiver consequently provided with a polarised pallet, and without spring regulation. The magnetic connecting bar of the line electro-magnet is replaced by a non-magnetic bar, or piece of copper, for example. Two electro-magnets are thus obtained with one branch, placed in juxtaposition in the same circuit, and having consequently four poles, of which two are utilised for the rotation of the type wheel and of the needle, and two for the impression.

1692. "Regulating electric currents." JOHN SCUDAMORE SELLON and HENRY EDMUNDS. Dated April 30. 6d. Great difficulties have hitherto been experienced in controlling the energy of the electric current, as, for example, in electric lighting by the incandescence of a rod or wire. Moreover, the motive force required to work the dynamo-electric machine has been, to a great extent, wasted when the electric current has proved too powerful for the work it was required to perform, the practice of shunting off the excess of electricity having been adopted, instead of the action of the motor being reduced. It is now proposed to introduce into the circuit an automatic switch, which, as a retaining or other wire, forming part of the switch, becomes heated by the passage of the current, will be brought into action and caused to connect the two collecting brushes of the dynamo-electric machine with each other, thereby causing the induced current to cease, and free the motive power engine of its work.

1766. "Demagnetising iron ships." EVAN HENRY HOPKINS. Dated May 5. 2d. Consists in the application of electro-magnets of a special construction to the framework of iron ships, or to the iron framework or structure of composite ships. (*Not proceeded with.*)

1791. "Electric lamps." JOHN SCUDAMORE SELLON and HENRY EDMUNDS. Dated May 6. 2d. Relates to regulating the energy of the electric current to each lamp in a circuit, by supplying all the lamps in a circuit with the maximum current required to secure the proper incandescence of any one of the lamps, and in such of the lamps as may not require the full current, by connecting

the two sides of the space bridged over by the incandescent wire, by passing as many fine wires from side to side as may be found necessary to carry over the surplus current. Also it consists of an arrangement for closing the circuit and cutting out any lamp of a series before the fusing point of the incandescent wire is reached; and, lastly, to a lamp in which two illuminating rods or wires are used, the second one being brought into circuit on the fusion of the first. (*Not proceeded with.*)

1813. "Electric type printing telegraph apparatus." GEORGE JONAS DROSTE. Dated May 7. 8d. Is intended to overcome the difficulty of obtaining synchronism in the driving mechanism of the Hughes' apparatus, which, it is stated, is increased when more than two apparatus are to be worked on one circuit, and with a greater number becomes an impossibility. The synchronism of the apparatus in a circuit is ensured by the mutual action of the electro-magnets and the driving mechanisms, which latter are connected with automatic current commutators and influence the same. (The claims are fourteen.)

1830. "Apparatus for composing, transmitting, and deciphering secret telegrams." HERBERT JOHN HADDAN. (A communication from Messrs. G. Schacher et Compagnie, of Paris.) Dated May 8. 2d. Consists in or of several alphabets or signs arranged on concentric circles on a transmitting or recording dial, on which circles the same letters or signs have different values given them, following some key. (*Not proceeded with.*)

1949. "Apparatus for generating electric currents." JOHN SCUDAMORE SELLON and HENRY EDMUNDS. Dated May 15. 2d. The object of this invention is to obtain induced currents of electricity (by the aid of rotating magnets), that these currents may be used for illuminating and other purposes without affecting the current which circles around the field magnets. (*Not proceeded with.*)

MR. SAM MENDEL has joined the board of the Western and Brazilian Telegraph Company (Limited), as deputy-chairman.

Messrs. C. J. Hambro and Son notify that a half-yearly dividend at the rate of 5 per cent. per annum will be paid on the shares of the Great Northern Telegraph Company on and after to-day.

The offices of the Indo-European Telegraph Company have been removed to 18, Old Broad Street, E.C

The Eastern Extension Telegraph Company (Limited), have declared an interim dividend for the quarter ending Sept. 30 last of 2s. 6d. per share, or at the rate of 5 per cent. per annum, free of income tax.

The Eastern Extension, Australasia and China Telegraph Company (Limited), notify that the coupons on the Five per Cent. Australian Government Subsidy Debentures, due to-day, will be paid on and after that date at Messrs. Barclay, Bevan and Co.'s.

The following are the final quotations of telegraphs for Dec. 29th:—Anglo-American, Limited, 57-57½; Ditto, Preferred, 82-82½; Ditto, Deferred, 33½-33; Brazilian Submarine, Limited, 7½-7¾; Cuba, Limited, 8½-9; Cuba, Limited, 10 per cent. Preference, 15½-16½; Direct Spanish, Limited, 2½-2¾; Direct Spanish, 10 per cent. Preference, 12-12½; Direct United States Cable, Limited, 1877, 10¼-10½; Eastern, Limited, 8⅝-8¾; Eastern, 6 per cent. Debentures repayable Oct., 1883, 102-104; Eastern 5 per cent. Debentures repayable Aug., 1878, 102-104; Eastern, 6 per cent. Preference, 11½-12; Eastern Extension, Australasian and China, Limited, 8¼-8½; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 106-109; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 101-103; Ditto, registered, repayable 1900, 102-104; German Union Telegraph and Trust, 8¼-8⅝; Globe Telegraph and Trust, Limited, 5-5¼; Globe, 6 per cent. Preference, 11-11¼; Great Northern, 8½-9½; Indo-European, Limited, 22½-23½; Mediterranean Extension, Limited, 2¾-3¼; Mediterranean Extension, 8 per cent. Preference, 10-10½; Reuter's Limited, 10-11; Submarine, 225-235; Submarine Scrip, 2½-2⅝; West Coast of America, Limited, 1¼-1⅝; West India and Panama, Limited, 1⅝-1⅞; Ditto, 6 per cent. First Preference, 7¼-7⅝; Ditto, ditto, Second Preference, 6½-7; Western and Brazilian, Limited, 5⅝-5¾; Ditto, 6 per cent. Debentures "A," 99-102, Ditto, ditto, ditto, "B," 97-101; Western Union of U.S. 7 per cent., 1 Mortgage (Building) Bonds, 120-125; Ditto, 6 per cent. Sterling Bonds, 105-107; Telegraph Construction and Maintenance, Limited, 34-36; Ditto, 6 per cent. Bonds, 106-108; Ditto, Second Bonus Trust Certificates, 2⅝-3; India Rubber Co., 12½-13¼; Ditto, 6 per cent. Debenture, 105-107.

TRAFFIC RECEIPTS.

Name of Co., with amount of issued capital, exclusive of preference and debenture stocks.	Anglo-American Co. £7,000,000.	Brazilian Sub. Co. £1,300,000.	Cuba Sub. Co. £160,000.	Direct Spanish Co. £116,379.	Direct U.S. Co. £1,213,900.	Eastern Co. £3,697,000.	Eastern Ex. Co. £1,997,500.	Gt. Northern Co. £1,500,000.	Indo-Euro. Co. £425,000.	Submarine Co. £338,225.	West Coast America Co. £300,000.	Western and Brazilian Co. £1,398,200	West India Co. £883,210.
	£	£	£	£	£	£	£	£	£	£	£	£	£
Nov., 1879 ...	67,380	*14,540	3,000	1,335	22,460	46,147	26,379	16,653	... ...	*a*	**	*12,337	4,707
Nov., 1878	51,090	12,753	2,609	1,002	17,030	37,170	25,980	16,587	... ...	9,549	2,200	.. ..	4,729
Increase	16,290	1,787	391	333	5,430	8,977	1,099	66	... ...	... ...	... ...	... ...	.. ...
Decrease	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	22

* Four weeks. ** October receipts, £12,000. *a*, not published at present.